THE RELATIONS BETWEEN HUMAN MORTALITY AND THE SEASONS OF THE YEAR

AT the anniversary meeting of the Scottish Meteorological Society, a very valuable paper was read by Dr. Arthur Mitchell, and the Secretary, Mr. Alex. Buchan, giving an account of their investigations on the subject of the influence of the seasons on human mortality at different ages as caused by different diseases. The authors have calculated the weekly average death-rate of London for the past thirty years for thirty-one diseases, together with the averages of temperature, moisture, rain, &c. Considering the weather experienced in the course of the year as made up of several distinct climates differing from each other according to the prevailing temperature and moisture and their relations to each other, the influence of these climates, characterised respectively by cold, cold and dryness, dryness and heat, heat, heat and moisture, and cold and moisture, on the mortality was pointed out. The weekly mortality from all causes and at all ages shows a large excess above the average from the middle of November to the middle of April, from which it falls to the minimum in the end of May; it then slowly rises, and on the third week of July shoots suddenly up almost to the maximum of the year, at which it remains till the second week of August, and thence falls as rapidly as it rose to a secondary minimum in October. Regarding the summer excess in the death-rate, which is so abrupt in its rise and fall, it was shown that it is wholly due to one section of the population, viz. infants under five years of age, none of the curves for the other ages showing an excess in the death-rate from all causes during the summer months; and it was further shown that the summer excess is due not only to the deaths at one age, but to the deaths from one class of diseases, viz. bowel complaints. The importance of weekly averages in discussing these sudden fluctuations of the death-rate to the changes of the weather was pointedly referred to. Deducting the deaths from bowel complaints from the deaths from all causes, the curve assumes a simple form, viz. an excess in the cold months and a deficiency in the warm months. In other words, the curve of mortality is dictated by the large number of deaths from diseases of the respiratory organs. The curve of mortality in London has thus an inverse relation to the temperature, rising as the temperature falls, and falling as the temperature rises. On the other hand, in Victoria, Australia, the curves of mortality and temperature are directly related to each other—mortality and temperature rising and falling together. The character of the curve of mortality in Victoria is impressed on it by the deaths of persons below the age of five; and among such young persons the special diseases which determine this influence are diarrhœa and dysentery. This peculiarity arises from its higher mean temperature, 57°·6, as compared with that of London, 50°·0. In London also during the hottest months of the year the curves of mortality and temperature rise and fall together, whereas in Victoria the curves are throughout the whole year directly related; for though doubtless the deaths from diseases of the respiratory organs fall as the temperature rises, and rise as the temperature falls, yet the number of deaths from these diseases is, owing to the comparatively high winter temperature, never sufficiently large to influence the curve of the whole death-rate. The curves of mortality for bronchitis and pneumonia at different ages prove that the fluctuation is much less for pneumonia than for bronchitis, and that the excess in both cases of infant mortality is great, but not nearly so great as the infant mortality for diarrhœa. The curves show that the maximum mortality from the different diseases group around certain specific conditions of temperature and moisture combined, the general result of which, as regards the principal diseases, may be thus roughly stated:—

Character of Weather	Maximum Mortality
Cold	Bronchitis, pneumonia, asthma, &c.
Cold and dry	Brain-disease, convulsions, whooping-cough
Warm and dry	Suicides, small-pox
Warm and moist	Diarrhœa, dysentery, cholera
Cold and moist	Rheumatism, heart-disease, diphtheria, scarlatina, measles, croup

The deaths from cancer and liver disease show no distinct relation to weather. The period of the year least marked by the occurrence of maximum mortality from any disease is the warm dry weather which prevails from the middle of May to the end of June. At this season the only maximum is a well-pronounced secondary maximum for measles; and the maxima for suicides and small-pox, which are, however, extended from the middle of April into these months. Convulsions, teething, and atrophy and debility have a secondary maximum in the warm moist weather of July and August. In the United States, where the heat is greater in summer, the secondary maximum for convulsions is more distinctly marked than that of London; and in Victoria the summer maximum is the only one that appears. The contrast offered by certain curves to each other in all points is very striking. Thus the curve for whooping-cough begins to rise above its average in the middle of December, attains its maximum in March and April, and falls to the minimum in September and October, whilst the curve for scarlatina is exactly the reverse of all this, having its minimum in spring and its maximum in autumn. It was inferred from the general teaching of the curves, that if a curve representing the progress of the death-rate from a particular disease were given for a place whose climate was known, though it might be impossible to name the exact disease, it would be possible to say with a considerable degree of certainty whether, for instance, the nervous system, or the respiratory organs, or the abdominal organs were involved in the disorder which caused the deaths.

CONFERENCE ON THE REGISTRATION OF PERIODICAL NATURAL PHENOMENA

THE Council of the Meteorological Society recently resolved to organise a system of Observations of Natural Phenomena, connected with the return of the seasons, as well as of such branches of physical inquiry as tend to establish a connection between meteorological agencies and the development of vegetable life.

As a preliminary to carrying out this intention they invited the various Societies before which such subjects most naturally come to nominate delegates to join a committee by whom the whole question as bearing upon agriculture, horticulture, &c., should be considered, and to whom also any written communications should be submitted.

The first meeting of this joint committee was held at the Office of the Meteorological Society, 30, Great George Street, on Thursday, July 2, when delegates were present and promises of co-operation read from the Royal Horticultural, Royal Agricultural, Royal Botanical, and other Societies. After the subject had been fully discussed the Rev. T. A. Preston, of Marlborough College, was requested to prepare a list of plants to be observed, and also to draw up a report on the same. Other gentlemen were requested to prepare lists of insects, birds, and animals.

THE SPECTRUM OF THE AURORA BOREALIS[*]

THE author's object in this paper is to make a small contribution towards the solution of the question, how the composition of the spectrum may be most correctly explained?

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[*] By the late Prof. A. J. Angström.

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It may be assumed that the spectrum of the aurora is composed of *two* different spectra, which, even although appearing sometimes simultaneously, have in all probability different origins.

The one spectrum consists of the homogeneous yellow light which is so characteristic of the aurora, and which is found even in its weakest manifestations. The other spectrum consists of extremely feeble bands of light, which only in the stronger auroræ attain such an intensity as enables one to fix their position, though only approximatively.

As to the yellow lines in the aurora or the one-coloured spectrum, we are as little able now as when it was first observed to point out a corresponding line in any known spectrum. True Piazzi Smyth (*Comptes Rendus*, lxxiv. 597) has asserted that it corresponds to one of the bands in the spectrum of hydrocarbons; but a more exact observation shows that the line falls into a group of shaded bands which belong to the spectrum, but almost midway between the second and third Herr Vogel has observed that this line corresponds to a band in the spectrum of rarefied air (Pogg. Ann. cxlvi., 582). This is quite right, but in Angström's opinion is found on a pure misconception. The spectrum of rarefied air has in the green-yellow part seven bands of nearly equal strength; and that the auroral line corresponds with the margin of one of these bands, which is not even the strongest, cannot be anything else than merely accidental.

Observations on the spectrum have not hitherto agreed with each other; partly, perhaps, because of the weak light of the object, but partly also, it may be, on account of the variability of the aurora. The red does not always appear, and when it does is often so weak that it cannot be observed in the spectroscope. If now it be assumed that the aurora has its final cause in electrical discharges in the upper strata of the atmosphere, and that these discharges, whether disruptional or continuous, take place sometimes on the outer boundary of the atmosphere, and sometimes near to the surface of the earth, this variability will easily show in the appearance of the spectrum what the observations appear to confirm.

If we consider the conditions under which the electric light appears on the boundary of the atmosphere, moisture in that region must be set down as nil, and consequently the oxygen and hydrogen there must alone act as conductors of electricity. Angström has tried to reproduce these conditions on a small scale. Into a flask, the bottom of which is covered with a layer of phosphate, the platinum wires are introduced and the air is pumped out to the extent of several millimetres. If the inductive current of a Ruhmkorff coil be sent through the flask, the whole flask will be filled, as it were, with that violet light which otherwise only proceeds from the negative pole, and from both electrodes a spectrum is obtained consisting chiefly of shaded violet bands.

If this spectrum be compared with that of the aurora, Angström thinks that the agreement between the former and some of the best established bands of the latter is satisfactory.

Lines		Wave-lengths		
Of the aurora spectrum . .	According to Barker .	431	470·5	
	,, ,, Vogel .	—	469·4	523·3
	,, ,, Angström	—	472	521
	,, ,, Lemström	426·2	469·4	523·5
	Mean . . .	428·6	470·3	522·6
Of the spectrum of the violet light . . .		427·2	470·7	522·7

In the neighbourhood of the line 469·4 Herr Vogel has moreover observed two weak light bands, 466·3 and 462·9. The spectrum of the violet light has also two corresponding shaded bands, 465·4 and 460·1.

Should the aurora be flamy and shoot out like rays, there is good reason for assuming a disruptive discharge of electricity, and then there ought to appear the strongest line in the line-spectrum of the air, the green, whose wavelength is 500·3. Precisely this has been actually observed by Vogel, and has moreover been seen by Angström and others.

Finally, should the aurora be observed as it appears at a less height in the atmosphere, then are recognised both the hydrogen lines and also the strongest of the bands of the dark-banded air-spectrum, as *e.g.* 497·3. There are found also again nearly all the lines and light bands of the weak aurora spectrum, whose position has with any certainty been observed.

There still remains the line in the red field, the wavelength of which, according to Vogel, may be valued at 630. Angström has chanced to see it only a single time, while on various occasions, when the aurora has shown red lights, he has found it impossible to distinguish any lines whatever in this part of the spectrum. The cause of this may be that while the red bands in the spectrum of the negative pole are broad and very feeble in light, the corresponding light in the aurora may be imperceptible in the spectroscope on account of the dispersion of the prism, although it is strong enough to give to the aurora a reddish appearance. Angström does not venture to decide whether the red line observed by Vogel coincides with the strongest of these bands, but so much is at least certain, that it may coincide with more than one of the bands to the red field of Plucker's air-spectrum.

In general it may be thus assumed that the feeble bands in the aurora spectrum belong to the spectrum of the negative pole, and that the appearance of this spectrum may be changed more or less by additions from the banded air-spectrum or the line-spectrum of the air.

But by this is not yet explained the one-coloured spectrum or the origin of the yellow line. The only explanation of the origin of this line which in Angström's opinion is in any way probable, is that it owes its origin to *fluorescence* or phosphorescence. Since fluorescence is produced by the ultra-violet rays, *an electric discharge may easily be imagined, which, though in itself of feeble light, may be rich in ultra-violet light, and therefore in a condition to cause a sufficiently strong fluorescence.* It is also known that oxygen is phosphorescent, as also several of its compounds.

There is therefore no need, in order to account for the spectrum of the aurora, to have recourse to the "very great variability of gas spectra according to the varying circumstances of pressure and temperature," a variability which according to Angström's twenty years' observations does not exist. Just as little can Angström admit that the way in which a gas may be brought to glow or burn, can alter the nature of the spectrum; since it is an established fact in physics that the state of light and of heat which puts a body into a glowing condition is unconnected in character with that which produces glowing.

Angström does not entirely deny the possibility that a simple body by glowing in a gaseous condition will offer several spectra. Just as one simple body can form a chemical combination with another, and this body by glowing in a gaseous condition, so long as it is not decomposed, gives its own spectrum, so must it also be able to form combinations with itself—thus to form isomeric combinations—it being always supposed that it exists in the gaseous form and can maintain itself in a glowing condition without decomposition. In this way it is indeed possible to conceive an absorption for oxygen which belongs to ozone; but since ozone, as is well known, cannot maintain itself in a glowing condition, it is in vain to look for more than one spectrum of oxygen. There is, however, at least a possibility of obtaining several spectra from sulphur, while again with respect to carbon, which cannot even be exhibited in a gaseous condition, a like assumption in the author's opinion wants the support of experience.

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